

The greater size, apical coloration, and markings of the under-surface readily distinguish this species from *T. eucharis*.

12. *Wings of the male with the orange patch narrow, not yellowish, only touching the ground-colour opposite to the end of discoidal cell; apex of primaries below grey-speckled; secondaries creamy whitish, reticulated with brownish green.*

129. TERACOLUS EVANTHE.

Anthocharis evanthe, Boisduval, Sp. Gén. Lép. i. p. 567. n. 13 (1836).

Callosune evanthe, Kirby, Syn. Cat. p. 500. n. 8 (1871).

S. Africa.

B.M.

Pieris doxo of Godart is probably a *Synchloë* allied to *S. suasa*; *Pontia eulinene*, Klug, is an *Iriax*; and *Anthocharis phanon*, Trimen, is described as allied to the latter, therefore probably belongs to the same genus.

EXPLANATION OF THE PLATES.

PLATE VI.

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|---------------------------------------------|--------------------------------------------|
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| 2. — <i>lyceus</i> , p. 141. | 8. — <i>halyattes</i> , p. 145. |
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PLATE VII.

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9. On the Structure of the Mucous Membrane of the Stomach in the Kangaroos. By EDWARD A. SCHÄFER, Assistant-Professor of Physiology, and D. JAMES WILLIAMS, Student of Medicine, in University College, London. (Communicated by A. H. GARROD, M.A., F.Z.S., Prosecutor to the Society.)

[Received December 17, 1875.]

(Plates VIII.—XI.)

The observations here recorded have been made upon the stomachs of two Kangaroos belonging to distinct genera. One was that of the great Kangaroo, *Macropus giganteus*; the other of *Dorcopsis luctuosa*, a specimen of which died some months back in the

gardens of the Society. This latter has been described (P. Z. S. 1875, p. 48) by Prof. A. H. Garrod, the Prosector to the Society, to whom we are indebted for the opportunity of examining the organ in question in these animals. Our original object was simply to record in general terms the differences in microscopic structure presented by those parts of the membrane which have a different appearance to the naked eye; but since, in spite of recent researches, our knowledge of the minute structure of the gastric mucous membrane is still confessedly imperfect, it became obvious that it would be necessary to enter upon a minute examination of the several parts; especially as they present very well-marked differences, and, in some cases, peculiarities of structure which tend to elucidate points yet in dispute with regard to the gastric mucous membrane of the higher Mammalia and of Man.

As is well known, the stomach is, in the Kangaroo, a long sacculated organ not unlike the human colon; and the sacculations, as in that, are due to the presence of three longitudinal bands of plain muscular fibre, situate on the exterior underneath the serous membrane and shorter than the rest of the gastric wall, so that this is bulged out at intervals into sacculi separated by constrictions or inward folds of the membranous wall. One of the three bands is placed below along the greater curvature; and it is on either side of this that the sacculi are most marked; there are none at the lesser curvature, nor is the pyloric extremity sacculated at any part of its circumference. Besides the inwardly projecting folds between the sacculi, and which involve all the coats of the stomach, the mucous membrane shows the rugæ ordinarily met with in a stomach not completely distended, and produced by contraction of the muscular coat. There are also in certain parts more minute folds, which would, no doubt, be effaced by complete distention of the organ, and which are probably due to a similar contraction of the muscular layer of the mucous membrane (*muscularis mucosæ*).

In the diagrams of the two stomachs which are here given, and in the accompanying general description, they are for convenience' sake treated as if they were more or less straight organs extending across the body from left to right as in the human subject, whereas in reality they are twisted upon themselves. A detailed description of the form of the marsupial stomach and its relations to other parts is, of course, foreign to the subject of the present paper, and must be sought for in recognized treatises on comparative anatomy*.

* The following are the dimensions of the organs as they appear after preservation in spirit:—

	<i>Dorcopsis</i>		<i>Macropus</i>	
	<i>luctuosa.</i>		<i>giganteus.</i>	
	ft.	in.	ft.	in.
Length along lesser curvature.....	1	0	1	8
Length along greater curvature, the sacculations not being taken into account	1	7	2	5
Length along greater curvature, reckoning in the sacculations	2	10	5	0
Greatest circular measurement	0	7	0	7

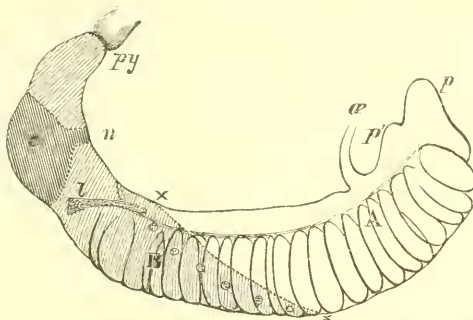
In both cases the stomachs were filled with partially digested food.

Obvious characters of the Mucous Membrane.

With the unassisted eye three distinct regions can be detected in the stomachs of both animals, the mucous membrane presenting well-marked differences in feel, appearance, and, as will be presently seen, in microscopic structure. For the most part they are marked off from each other by distinct lines of demarcation; these, however, are more obvious between the first and second regions than between the second and third, although, in the latter case also, especially in *Dorcopsis*, the distinction can be made out even with the naked eye.

In the two species examined these three regions have somewhat different distributions, as is indicated in the accompanying diagrams. Thus, in *Dorcopsis* (Diagram 1) the first or cardiac region (A), which

Diagram 1.

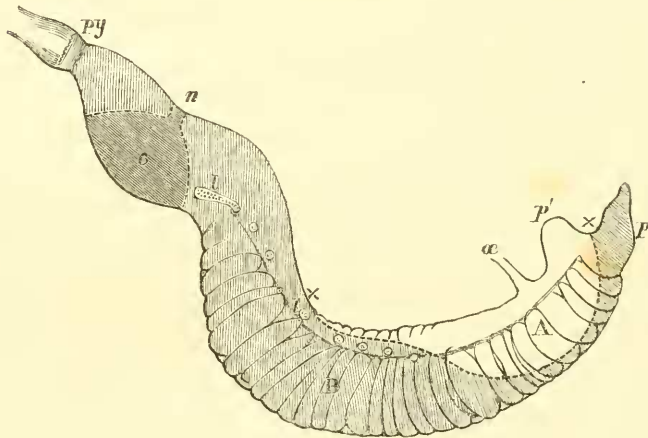
Stomach of *Dorcopsis luctuosa*.

is covered with an epithelium obviously continuous with and similar to that of the gullet, occupies more than a third of the inner surface of the organ, lining the whole of the cardiac fundus, and terminating towards the middle of the stomach by a well-marked line of demarcation (\times), which extends from the lesser curvature obliquely downwards and to the left along the anterior and posterior walls to end in the greater curvature about opposite to the opening of the gullet, or a little to the right of that point. Commencing on either side of the cardia two parallel ridges or folds of the mucous membrane (not represented in the diagram) pass for about 3 inches along the lesser curvature, depending into the cavity of the organ. They are little more than half an inch apart, and not quite half an inch in depth; they become less prominent and gradually subside towards their termination. They bring to mind the ridges which are found in a somewhat similar situation in the Ruminant stomach, but they are by no means so strongly muscular. The second region (B) commences at the oblique line above traced out, which separates it from the first or cardiac region, and extends from here to the left, as far as the pylorus, comprehending all the rest of the inner surface of the organ except a circular patch (C) about $2\frac{1}{2}$ inches in diameter, which occupies the

pyloric fundus. This patch is distinguishable to the unaided eye chiefly by its greater thickness, smoother surface, and by a slight furrowed line which partly encloses it. It shows under the microscope glands differing in character from those of the surrounding region, and is therefore here described as a *third* region of the mucous membrane. But this third region is not entirely confined to the circular patch; for a narrow tract of mucous membrane (*n*) containing similar glands extends from the upper limit of the patch on either side to meet its fellow above at the lesser curvature, thus completing an irregular zone around this part of the stomach.

In *Macropus giganteus* the epithelium of the first region (Diagram 2, A) has a much more limited distribution than in *Dorcopsis*. The tract which it covers is widest in the neighbourhood of the gullet, whence it passes over the front and back of the stomach. Even here it does not extend as far down as the greater curvature; so that the two parts do not meet below. Moreover the left end of the stomach, which terminates in a pouch-like projection (*p*), is not lined by this epithelium, although a second smaller pouch (*p'*), directed upwards and situated nearer the gullet than the first one, receives a lining from it. Both these pouch-like projections are

Diagram 2.

Stomach of *Macropus giganteus*.

present also in *Dorcopsis luctuosa*; but they are both lined with hard epithelium like that of the rest of the cardiac fundus in this animal. Anteriorly the hard epithelium gradually narrows in *Macropus giganteus* until it becomes reduced to a mere strip along the lesser curvature, and eventually ceases altogether about halfway between the two extremities of the stomach. The ridges of mucous membrane which extend towards the right from either side of the cardiac

orifice are only slightly marked in the stomach of *Macropus*. The second region (B) has a greater extent in *Macropus giganteus* than in *Dorcopsis*. It occupies all the rest of the inner surface of the stomach except (as in *Dorcopsis*) a circular patch (C) about 3 inches in diameter, situate at the pyloric fundus, and not marked off from the rest by any well-defined naked-eye appearances except the great thickness of the mucous membrane. But microscopical examination shows that the glands of this patch present material differences from those of the rest of the stomach, whilst resembling those of the corresponding part of the *Dorcopsis* stomach; so that this patch is to be taken as representing the third region in *Macropus* also. The tract *n*, moreover, which passes in *Dorcopsis* over the upper part of the stomach in this place, is also represented in *Macropus*. The second region may be said to commence at the extreme end of the cardiac fundus, where its mucous membrane lines the pouch (*p*) above referred to as not being covered by the hard gullet-epithelium; from here it passes to the right, along the greater curvature of the stomach, gradually narrowing at first, so that opposite the œsophagus it forms a strip only about $\frac{3}{4}$ of an inch wide, bounded on either side by the epithelium of the first region, but subsequently becoming gradually wider until it extends continuously round the organ.

In both animals the mucous membrane of the second region has here and there insular elevations flattened on the surface and beset all over with small rounded eminences, each with a little pit at its summit as if made with the point of a pin. These elevated patches vary in size, but seem to have a fairly regular distribution (Diagrams 1 and 2, *l*, *l*). Thus in both animals there is a large triangular patch on each wall of the stomach, the base of which is close to the third region of the mucous membrane, while the apex of the triangle extends upwards and to the left towards the lesser curvature. From near the apex a chain of smaller and more circular patches is continued for some distance parallel to the line of demarcation between the first and second regions—in *Dorcopsis*, in fact, as far as the second region extends. As the result of microscopical examination clearly shows, these elevations are owing to accumulations of lymphoid tissue in and beneath the mucous membrane; and they may therefore be termed “lymphoid patches.” They are in many respects analogous to Peyer’s patches of the small intestine.

Microscopical Characters of the Mucous Membrane.

The results of the microscopical examination of the several regions correspond for the most part in both animals (as might indeed have been expected in genera so closely allied); so that the same description will apply to both. We shall afterwards take the opportunity of pointing out any special peculiarity which may obtain in either. The figures, which have been taken indiscriminately, some from the one animal and some from the other, will, for the most part, serve to illustrate the structure of the corresponding parts in both.

The Mucous Membrane of the First Region.—This is covered with a coating of dense stratified epithelium (Plate VIII. fig. 1, *S*) con-

tinuous with that of the gullet, and resembling it in all respects. It is harsh to the feel, and in this respect contrasts strongly with the soft mucous membrane of the second and third regions. It is unnecessary to enter into details of structure as regards this epithelium, since it resembles others of its class, the lowermost cells (*c'*) being rounded or somewhat columnar, the layers above these composed of polyhedral elements with dentated or ridged surfaces, and those above these again swollen and enlarged; finally, most superficial of all are several strata of flattened scaly cells forming a horny layer (*h*) distinguished, both by its somewhat fibrous appearance in section and by its different reactions to staining fluids, from the Malpighian layer or layers upon which it rests. Here and there one or two lymphoid corpuscles are to be seen in between the deeper epithelium-cells. A few papillæ of the mucous membrane project into the deeper parts of the epithelium; but neither an inspection of sections that were made from different parts, nor a careful examination of the surface, could detect any racemose or tubular glands of any sort in the region covered by this epithelium. At the line of demarcation separating it from the glandular portion of the stomach, the surface of the mucous membrane undergoes an abrupt change, perceptible as easily by the unassisted eye and hand as with the aid of the microscope. The manner in which the change takes place is represented in the figure, but will be more readily understood after the structure of the succeeding portion of the stomach has been described. It is sufficient here to mention that all the layers of cells of which the stratified epithelium is composed cease abruptly, with the exception of the deepest layer; this, on the contrary, becomes directly continued into the simple layer of columnar epithelium which covers the whole of the glandular portion, and which sends prolongations into the mouths of the glands.

The Mucous Membrane of the Second Region.—This region and the remaining one include the whole of the glandular portion of the organ. The mucous membrane is soft to the feel and of considerable thickness; and its surface is closely dotted with the orifices of the tubular glands (Plate IX. fig. 2), which are densely arranged and pass either vertically or somewhat obliquely through the whole thickness of the membrane (which may, indeed, be stated to be in a large measure composed of them) as far as the muscularis mucosæ (*m. m*), which, as in man, limits the mucous membrane and separates it from the submucous areolar tissue. Each gland-tube is bounded (or rather may be said to be formed) by a delicate basement membrane, appearing in section as a mere line outside the epithelium of the gland. The tubes are cylindrical for the greater part of their length, but are somewhat enlarged towards the orifice, and also usually swollen out at the bottom (*b*). The surface of the mucous membrane between the orifices of the tubular glands is, as usual, covered by a single layer of characteristic columnar epithelium-cells (*c*), with the attached ends tapering, apparently designed, like the bricks in an arch, to accommodate themselves to the rounded surface to which they are attached; and this epithelium is con-

tinued also into the openings themselves. Tracing it further into the gland, we find the cells, still columnar, less tapering at their fixed extremities; and, moreover, while in the mouths of the glands, as on the general surface, they stand vertical to the basement membrane with their free ends on the same level, in the throat of the glands, on the other hand, they slant upwards, so that they more or less overlap one another (fig. 2, *n*). Further downwards in the tube the cells become gradually shorter, so as to appear quadrangular or cubical in form; at the same time the lumen of the tube becomes much narrowed, and, indeed, in vertical sections of the mucous membrane is in some parts hardly perceptible. These shortly columnar or cubical epithelium-cells occupy the greater part of the length of the tube (*m*). They have each a very distinct round or oval nucleus with one or two nucleoli; and the protoplasm of the cell, which is granular in appearance, becomes stained by logwood, although not nearly so intensely as the nucleus.

Towards the fundus (*b*) of the gland the cells undergo a change. They become gradually larger, and rounded or polyhedral in shape; their outlines become more distinct; and the substance of the cell acquires a clear or very faintly granular aspect, and, moreover, becomes hardly at all stained by logwood. Further, the nuclei, for the most part, have not their usual characteristic vesicular appearance, but in most of the cells (which line, and in some cases almost fill, the fundus), appear as intensely stained, shrunken or compressed bodies, usually situated excentrically in the cell, and not frequently flattened up against the basement membrane. In short, the appearance of these polyhedral cells of the fundus of the gland brings strongly to mind the cells which occupy the alveoli of the salivary gland (submaxillary); and it is not impossible that the clear, swollen-out aspect they present may be due to a cause similar to that to which the salivary cells are believed to owe their characteristic appearance, the presence, namely, within the cells at the time of death of mucus or some similar substance, which swells up on the addition of fluid. Or it may be that the protoplasm of these lowermost cells is younger and less changed than that of the other cells of the gland, and consequently that they are more readily acted upon by reagents, or by the secretion of the gland itself after death, than the rest. At any rate there seems a close analogy between the structure of the deeper parts of these tubular glands and the alveoli of the compound racemose glands. At the same time it must be remembered that some of the latter class of glands, the pancreas for example, do not exhibit the clear, swollen-out cells with excentrically placed nuclei, but their alveolar walls resemble more, on the contrary, the cubical cells of the middle parts of the tubular glands above described; and it is worthy of note that in some parts of the second region of the Kangaroo stomach, those for instance in the neighbourhood of the pylorus, the tubular glands, which are here very long, are lined in the deeper as well as in the middle parts, by cubical or shortly columnar cells which are similar throughout.

The substance of the mucous membrane between the tubular

glands of the second region is in most parts composed of delicate connective tissue with numerous corpuscles, supporting the blood-vessels. Here and there well-defined cleft-like spaces are seen in the sections. These, no doubt, represent the lymphatics which are now known to be so numerous in the gastric mucous membrane*. They are particularly large and well marked in the neighbourhood of the pylorus (fig. 5).

In some places the interglandular tissue contains a considerable number of lymphoid cells; but this is more particularly the case in the neighbourhood of the lymphoid patches, to the description of which we shall immediately come. Moreover a certain amount of lymphoid tissue may intervene between the bases of the glands and the muscularis mucosæ. This last-named layer consists in most parts of two strata of muscular fibre-cells which cross one another, the inner being circular, the outer longitudinal in direction. From the more superficial or inner stratum bundles of fibre-cells pass up here and there between the glands, towards the surface; but it has not been easy to trace their ultimate destination. Probably they become eventually attached to the basement membrane.

Structure of Lymphoid Patches.—These localized elevations or thickenings differ from the rest of the mucous membrane of the second region in the fact that both mucosa and submucosa are largely formed by lymphoid tissue, *i. e.* lymph corpuscles supported by a fine retiform tissue. This (fig. 3) extends in the mucosa towards the surface of the membrane between the glands, and is also found as a distinct stratum at their base. In the submucosa it forms a layer of some thickness immediately underneath the muscularis mucosæ. The lymphoid tissue does not form a uniform layer, but is gathered at intervals into well-marked nodules or follicles (fig. 4), which cause the small rounded elevations already noticed on the surface of the lymphoid patch. Each of these elevations is, it will be remembered, marked with a small central pit (*d*). At the bottom of this the tubular glands fail, and the summit of the follicle is separated from the free surface merely by the layer of columnar epithelium, which itself contains numerous lymph corpuscles between the columnar cells; and these are also to be noticed free within the depression, as if they had emigrated from the subjacent lymphoid nodule. Indeed it may be doubted whether in some instances the covering of epithelium over the summit of the nodule may not be altogether absent; some of the sections obtained appear to show this; but it is possible that it may have become accidentally detached. Below the lymphoid layer of the submucosa is the ordinary connective tissue of that tunic (*s. m*) supporting the larger blood-vessels, nerves, and lymphatics; and at the base of each follicular accumulation there is commonly (as shown in fig. 3) a large lymphatic sinus, into which the follicle partly dips. At other places the lymphoid tissue of the mucosa is separated from that of the submucosa by the layer of muscularis mucosæ (fig. 3, *m. m*); but the latter is wanting opposite the summit of each follicle (fig. 4), and the lymphoid tissue

* Lovén, Nord. Med. Arkiv, 1873.

of the one blends with that of the other. In this particular, as in most others, the lymphoid patches of the Marsupial stomach exactly resemble the patches of Peyer of the human ileum, only that in the latter the lymphoid follicles occupy more of the mucous membrane and come entirely to the surface, whereas, in the gastric patches in question, the follicles, as well as the remainder of the lymphoid tissue, are surmounted by tubular glands, except at the centre of each, where the surface is pitted in as far as the summit or cupola of the follicle. The glands over these lymphoid patches are somewhat shorter than those which are found in the rest of the mucous membrane of the second region, but entirely agree with them in structure (figs. 3 & 4).

Transition of the Stratified Epithelium of the First Region into the simple Columnar Epithelium of the Second Region.—The manner in which this occurs will be readily understood by again referring to fig. 1. Close to the limit between these two regions the stratified epithelium (S) of the first is of considerable thickness, nearly as thick, indeed, as the whole mucous membrane of the second. If the lower line of the epithelium be followed, it will be seen that just as it approaches the junction it rises rather abruptly towards the surface, the layers of cells above it being continually less and less numerous until they are reduced to six or eight only. The lowermost columnar cells (c') of the stratified epithelium then become directly continued into the simple columnar epithelium (c) of the glandular region, whilst the layers above it cease abruptly, one or two cells often projecting at the edge like bricks from the end of a wall. The tubular glands begin immediately beyond this, the first ones passing down parallel with the ascending line of the stratified epithelium; but they are separated from it by somewhat more of the tissue of the mucosa than they are from one another. This tissue (i, i') contains very numerous lymphoid cells, and many are seen also in between the lower cells of the stratified epithelium of the immediate neighbourhood (at ly). Transitional forms of epithelium between the scaly stratified and the columnar (as described by Henle at the line of transition of gullet into stomach-epithelium in man) do not occur, but the passage of the one into the other is quite abrupt and effected by the cessation of all the layers of the stratified epithelium except the lowermost.

Structure of the Second Region, in the neighbourhood of the Pylorus.—The lining membrane as well as the muscular coat is here very thick, especially in *Macropus giganteus*; and the gland-tubes are correspondingly long (fig. 5). They are not enlarged at the fundus; and the cells of this are similar in appearance to those of the rest of the tube. Numerous bundles of muscular tissue (m', m'') pass from the muscularis mucosæ upwards towards the glands. But the most striking feature of the part is the number and size of the lymphatics (l, l'). These appear in sections as large well-defined clefts in the connective tissue between the glands. The clefts are not merely accidental; for they have a definite wall of flattened nucleated cells, like the commencing lymphatics elsewhere.

Two such clefts of considerable size are seen between the glands in fig. 5; other smaller clefts, also for the most part representing sections of lymphatics, are seen in the interglandular tissue in various parts of the mucous membrane. It will be observed, moreover, that the lymphoid tissue at the base of the glands is more abundant here than in the rest of the second region (fig. 2), with the exception of the lymphoid patches, and that the prolongations of the muscularis mucosæ towards the surface between the glands are more numerous (*m. m.*).

The Mucous Membrane of the Third Region.—This is very thick both in *Dorcopsis luctuosa* and in *Macropus giganteus*, the thickness being as usual due to the length of the gland-tubes. These resemble in many respects the pyloric part of the second region just described; thus they are long straight tubes lined near the orifice with columnar epithelium, and in all the rest of their extent with small cubical or polyhedral cells, which in many parts nearly fill up the tubes. But there is this important difference, that superadded to these and situated outside of them (but still within the basement membrane, which they often cause to bulge outwards) there are, in the middle parts of the length of the gland (figs. 6 & 7), certain other cells of a spheroidal or ovoidal shape and granular appearance. These are what have long been known as peptic cells; since it is believed, although it has not yet been conclusively proved, that they are the source of the pepsin of the gastric juice. They were termed by Rollett* the delomorphous cells of the gland, whilst the other, more centrally situated, and usually less obvious cells, which are continuous above with the columnar epithelium of the surface, he has termed adelomorphous. For the present it will be better to adhere to the old terminology (*peptic cells*) for the rounded cells, and to term the angular ones, which line the whole tube within them, *central cells*. The glands, moreover, in which the peptic cells occur we may continue to term the peptic glands, and the region of the stomach occupied by them the peptic region, without at the same committing ourselves so far as to maintain that the other portions of the stomach do not also, as some physiologists think, yield pepsin.

To return to the structure of the glands. The spheroidal peptic cells vary in number in different glands, being fewest in the parts of the peptic region which are nearest the boundary between this and the second or general glandular region. It frequently happens that these peptic cells do not reach the fundus (*b*) of the gland, which is not larger in these glands than the rest of the tube, and is occupied exclusively by central cells which resemble the cubical cells of the other glands, but are smaller and more closely packed. The distribution of the peptic cells in the glands is well shown in fig. 6, which is a sketch of part of a vertical section from the middle of the peptic region as seen under a low power. The preparation was stained with aniline blue, according to Heidenhain's directions†; the peptic cells become much more deeply stained by this than the rest

* Untersuchungen, 1871.

† Arch. f. mikr. Anat. vi. 1870.

of the tissue, and the limit of their distribution can be readily made out. They are seen to be absent near the orifices of the glands, where the tubes are lined with columnar epithelium.

The relation of the peptic cells to the central cells is best seen in the horizontal sections (as in fig. 8, which is taken from the *Dorcopsis* stomach). Here the peptic cells (*p, p*) lie immediately outside the central cells (*c, c*) (which almost fill up the tube, leaving but a very small lumen) and in close contact with them. But in *Macropus* the contact is not so close; for the basement membrane of the gland sends horizontal lamellar projections inwards, partially surrounding the spheroidal cells and separating them more from the central ones.

It can be clearly made out (both in vertical sections showing the glands along their whole length, and in sections carried obliquely across them so that in different parts of the section different levels of the tubes are cut) that the central cells are directly continuous at the neck of the glands with the gradually shortening columnar cells of the gland-mouth, and resemble, therefore, in this respect the cubical cells which line the greater part of the tubes of the second region*. In general aspect too the central cells resemble those; but they are for the most part, as before mentioned, smaller and more angular and closely packed. This is especially the case at the base of the gland, where the cells almost entirely fill the tube so as to leave little or no lumen (fig. 9).

Transition between the Second and Third Regions.—The line of demarcation between these is best marked, as before stated, in *Dorcopsis*, where there is a slight furrow between them, the mucous membrane increasing rapidly in thickness on the peptic side of the furrow. A section across the line and including a part of each region, is shown in fig 10, as seen under a low power in a preparation stained with aniline blue. The glands of the second region become gradually shorter until opposite the bottom of the furrow, where they are shortest; those beyond rapidly increase in length, but exhibit at first exactly the same structure. At about the third or fourth row, however, a few peptic cells become superadded to the others about the middle of the glands; and these increase in number and occupy a greater length of the gland as we proceed further into the third region, until after a few more tubes they are found throughout the greater part of the length of the glands; so that from a study of the mode in which the two kinds of glands pass into one another, as well as from a comparison of their structure, it is clear that the main parts of the glands of both regions are almost precisely similar and will probably have a similar function, and that the only difference of importance lies in the fact of the superaddition of the peptic cells in the glands of the third region—probably implying the superaddition of some other function in these glands. Whether this, as is generally believed, is the elabo-

* Strictly speaking, these cells are not cubical; for although they appear so when the glands are seen longitudinally, they must of course, as seen in a transverse section of the glands, become narrower towards the lumen; so that the shape of each cell is in reality that of a truncated wedge.

ration of pepsin, we hope that before long the results of some comparative experiments already commenced will enable us to form a definite opinion.

In the foregoing account we have been induced to enter into what might seem almost unnecessarily minute details with reference to the structure of the gastric mucous membrane in these particular animals, because, as we have already incidentally mentioned, they seemed to us especially well adapted for investigation, partly on account of the well-marked differences between the glands of different regions, combined at the same time as they are with many unmistakable features of similarity, partly on account of the ease and certainty with which the regions can be mapped out, and partly also on account of the simplicity of form of the glands, which renders them easy of observation throughout their whole length.

The identity between the glands of the third region here described and the well-known *peptic glands* of the stomach has been already incidentally noticed, and is sufficiently obvious. It will doubtless also have suggested itself to most of our readers that the glands here described as occupying the second region in the Kangaroo's stomach, and consequently by far the larger portion of the glandular mucous membrane, resemble in most points of structure those which were until the last few years known as the *mucous glands* of the stomach of Man and the higher Mammalia. But the resemblance is more obvious, both as regards situation and structure, in the part of the second region which is near the pylorus, than in the remainder. In the latter the epithelium of the glands presents peculiarities which have not hitherto, it is believed, been noticed in the gastric glands of other animals. These peculiarities are not improbably connected with the nature of the food on which the Kangaroo subsists. Further investigation is necessary to show to what extent they are found in other animals in which the food is similar.

DESCRIPTION OF THE PLATES.

PLATE VIII.

Fig. 1. Vertical section of the mucous membrane of the stomach of *Macropus giganteus*, carried across the line of junction between the first and second regions. Magnified about 135 diameters. *A*, end of first region or region of stratified epithelium; *B*, commencement of second region; \times , junction of the two; *S*, stratified epithelium; *p, p*, papillæ of corium rising up into this; *c'*, lowermost columnar cells of the Malpighian layer of the stratified epithelium; *h*, horny layer of ditto; *ly*, lymphoid corpuscles between the cells of the Malpighian layer; *gl*, tubular glands of mucous membrane of second region; *o, o*, their orifices; *c*, columnar epithelium of the surface; *i, i*, interglandular tissue with numerous lymphoid cells; *m, m*, muscularis mucosæ; *v*, blood-vessels cut across.

PLATE IX.

Fig. 2. Vertical section of a part of the second region of the mucous membrane, showing three of the tubular glands, of *Macropus giganteus*. Magnified

about 260 diameters. *n*, neck, *m*, middle part, *b*, fundus, *o*, orifices of the glands; *c*, columnar epithelium of the surface continued into the mouths of the glands; *m.m.*, muscularis mucosæ; *v, v*, blood-vessels cut across.

- Fig. 3. Vertical section of part of a lymphoid patch, from the stomach of *Macropus giganteus*, showing three of the tubular glands. Magnified about 260 diameters. *o, o*, orifices of the glands; *c*, columnar epithelium of the surface; *n*, neck, *m*, middle part, *b*, base or fundus of the glands; *m.m.*, muscularis mucosæ; *s.m.*, submucosa; *l.l.*, lymphoid tissue.
- Fig. 4. Section of a nodule or follicle from lymphoid patch of stomach (*Dorcopsis luctuosa*). Magnified about 60 diameters. *F*, follicle; *d*, depression or pit in the mucosa over the follicle; *gl*, glands of the mucosa with lymphoid tissue between them and at their base; *m.m.*, muscularis mucosæ; *s.m.*, submucous areolar tissue with lymphoid tissue near muscularis mucosæ; *l.s.*, lymphatic sinus at base of follicle.

PLATE X.

- Fig. 5. Vertical section of mucous membrane of second region of stomach near the pylorus (*Macropus giganteus*), showing six of the tubular glands. Magnified about 135 diameters. *c*, columnar epithelium of the surface; *o, o*, orifices of the glands; *l, l*, lymphatic vessels in the interglandular tissue of the mucous membrane; *m'. m'*, bundles of plain muscular tissue passing up between the bases of the glands from the muscularis mucosæ, which is not represented in this figure.
- Fig. 6. Vertical section of the third or peptic region of stomach (*Dorcopsis luctuosa*). Magnified about 60 diameters. *p*, part of the glands which contain peptic or delomorphous cells; *b*, bases of the glands destitute of these; *m.m.*, muscularis mucosæ.

PLATE XI.

- Fig. 7. Middle part of three tubular glands from vertical section of peptic region of the stomach (*Dorcopsis luctuosa*). Magnified about 260 diameters. *p, p*, peptic cells; *c, c*, central or adelomorphous cells.
- Fig. 8. Horizontal section of peptic region at level of middle of the glands (*Dorcopsis luctuosa*). Magnified about 260 diameters. *p, p*, peptic cells, *c, c*, central cells, *b.m.*, basement membrane of glands; *v, v*, capillary blood-vessels cut across in the interglandular tissue.
- Fig. 9. Base or fundus of one of the peptic glands, seen to be occupied entirely by the angular central cells (*Dorcopsis*). Magnified about 260 diameters.
- Fig. 10. Section across the line of demarkation between the second and third regions of the gastric mucous membrane (*Dorcopsis luctuosa*). Magnified about 60 diameters. *B*, mucous membrane of the second region; *C*, mucous membrane of third or peptic region; *× ×*, depression at the junction between the second and third regions; *p*, parts of the glands of the third region which contain the peptic cells; *m.m.*, muscularis mucosæ.

Figs. 1, 2, 3, 4, and 5 are from preparations which had been coloured with logwood-alm; figs. 6, 7, 8, 9, and 10 from sections stained with aniline blue. In figs. 6 and 10 the outlines of the glands are only roughly indicated.